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BOTANY.—*Revision of the genus* Myrrhidendron.[1]

JOHN M. COULTER, Boyce Thompson Institute, and J. N. ROSE, National Museum.

In 1894 we published, in the Botanical Gazette, the description of a very remarkable genus of Umbelliferae, from the high mountains of Costa Rica. This plant had been obtained by Capt. John Donnell Smith as one of the results of his energetic pioneer field work in Central America. Through his generosity we were able to accompany this description with a beautiful lithographic plate, made from a drawing by the late C. E. Faxon. Nothing more was learned of this genus until 1911, when Dr. William R. Maxon and Mr. Henry Pittier collected a similar plant high on the slopes of the volcano Chiriquí, in Panama. Again, in 1917, Dr. F. W. Pennell collected on the páramos of western Colombia a third species, which we have named in his honor. While studying this new plant from Colombia, we had occasion to re-examine Bentham's *Arracacia glaucescens*, and have reached the conclusion that this also should be referred to Myrrhidendron, thus raising the number of species to four.

KEY TO SPECIES

Leaflets more or less irregularly cleft or lobed.....1. **M. glaucescens**
Leaflets not lobed, or rarely some of them with 2 or 3 lobes.
Rachis with a dense ring of short hairs at the base of the pinnae and leaflets
2. M. Pennellii
Rachis without a dense ring of short hairs at base of leaflets.
Rays and pedicels glabrous.....**3. M. Maxonii**
Rays and pedicels pubescent.....**4. M. Donnell-Smithii**

[1] Received March 12, 1927.

1. Myrrhidendron glaucescens (Bentham) Coulter & Rose

Arracacia glaucescens Bentham, Pl. Hartw. 187. 1845.

Herb, 1 meter high or more, stout, glabrous; basal and lower stems long petioled, with large vaginate stipular bases; blade ternate, then pinnate; ultimate segments strongly veined beneath, cleft, the lobes sharply serrate; umbel strongy petioled; involucel bracts several, more or less elongated, toothed; involucels narrow, entire or 3-toothed at apex; fruiting rays 15 to 20, about equal, 6 to 8 cm. long, somewhat hispid on the angles; pedicels 6 to 10 cm. long; fruit oblong, 8 to 10 mm. long, glabrous.

Type locality: "Hacienda de Iravi, prope pagum Perucho," Colombia.

We have not seen Hartweg's type of this species, but we have Purdie's specimen from Colombia collected in 1849 and F. W. Pennell's plant from the forests near the edge of the Páramo de Ruiz, in the Quindío, altitude 3,200 to 3,500 meters (no. 2997), and the plant of J. Triana from the forest of Quindío, altitude 2,600 meters, collected 1851 to 1857 (in the Columbia College Herbarium).

2. Myrrhidendron Pennellii Coulter & Rose, sp. nov.

Herb, caulescent, perhaps a meter high or more, glaucous, glabrous except the top of the stem and inflorescence; basal and lower leaves unknown; petioles of upper leaves broadly stipular; rachis glabrous except at the base of the pinnae and leaflets, here bearing a conspicuous ring of hairs; blade ternate, then pinnate; leaflets lanceolate, acuminate, 2 to 5 cm. long, sharply serrate, glabrous on both sides; peduncle 1 to 2 cm. long, more or less mealy-pubescent, tending to become glabrate below; involucre none; involucel bractlets conspicuous, sometimes entire but usually strongly lacerate at the apex; rays numerous, nearly equal, 4 to 6 cm. long, pubescent; pedicels 8 to 10 mm. long; fruit oblong.

Type in the U. S. National Herbarium, no 1,042,584, collected near the Páramo de Ruiz in the Quindío, Colombia, altitude 2,600 to 2,800 meters, December 15 to 17, 1917 by F. W. Pennell (no. 2993). Also collected near Quindío Pass, August 2, 1922, by Killip and Hazen (nos. 9166 and 9452) at altitudes of 3,200 to 3,500 meters.

3. Myrrhidendron Maxonii Coulter & Rose, sp. nov.

A slender shrub, 3 to 4 m. high, crowned by a rosette of leaves, 3 to 4 dm. long, 3 to 4 times ternately compound; stipular sheaths of the petiole not greatly enlarged, about half the length of the petiole itself; leaflets lanceolate, acuminate, sharply serrate, the teeth bristle-tipped; umbel many-rayed; rays 5 to 10 cm. long; pedicels 1 to 1.5 cm. long; involucre usually a single large bract; involucel bractlets several, laciniately cleft toward the apex; fruit narrow, 2 cm. long.

Type in the U. S. National Herbarium, no. 675,668, collected on Cuesta Grande, eastern slope of Chiriquí Volcano, Panama, altitude 2,000 to 2,990 meters, March 11 to 13, 1911, by William R. Maxon (no. 5311). Collected also at the same place and time by H. Pittier (no. 3099).

4. MYRRHIDENDRON DONNELL-SMITHII Coulter & Rose, Bot. Gaz. 19: 466. 1894.

A small tree, 3.6 to 4.8 m. high; trunk 7.5 cm. in diameter; leaves large, 30 cm. or more long, ternately compound; leaflets ovate to lanceolate, 2.5 to 5 cm. long, acute, sharply and often irregularly serrate, the teeth more or less mucronate-tipped, glabrous, shining and impressed-veiny above, dull and paler beneath and conspicuously reticulate; petiolules with a prominent stipular ring which is more or less glandular-tufted; petioles large, inflated; peduncles short; involucre few-leaved; involucels numerous, 3 or 4-toothed or cleft near the apex, scarious-margined and strongly purplish-veined; inflorescence more or less glandular-puberulent; rays numerous, rarely equal; pedicels 8 to 10 mm. long; fruit linear, 10 to 12 mm. long, glabrous.

Type locality: Lava beds at the summit of the Volcano Irazú, Costa Rica.

Besides the type specimen this plant has been collected in Costa Rica on the Volcán de Turrialba, 1924, by Paul C. Standley (no. 35056), and in 1899 by H. Pittier (no. 13214); on the Volcán Poás, 1924, by Paul C. Standley (no. 348681), and, 1890, by H. Pittier (no. 2012); and on Cerro de las Vueltas, 1925–26, by Paul C. Standley (no. 43970).

BOTANY.—*Two new grasses from South America.*[1] A. S. HITCHCOCK, Bureau of Plant Industry.

Recently a package of grasses was received from the Museu Nacional do Rio de Janeiro, Brazil, which included many interesting specimens. Among them was an undescribed species of *Olyra* which I take pleasure in naming for the Director of the Museum, Dr. Alberto José de Sampaio, who sent me the specimens and who collected most of them, though this interesting species of *Olyra* was collected by José Vidal.

The new species, described below, differs conspicuously from all other species of *Olyra* in the condensed inflorescence and the villous-ciliate spikelets.

Olyra Sampaiana Hitchc., sp. nov.

Plant perennial; culm erect, retrorsely scaberulous, pubescent below the panicle, about 35 cm. tall, naked below, the sheaths bladeless, bearing two foliage leaves above, the nodes appressed-pubescent; sheaths slightly retrorsely scaberulous, ciliate on the overlapping margin, 6 to 7 cm. long; ligule 1 to 2 mm. long, truncate; blades thin, oblong-lanceolate, abruptly rounded below into a short puberulent petiole about 2 mm. long, gradually narrowed to an acuminate apex, glabrous on the upper surface, antrorsely scabrous beneath, 13 to 15 cm. long, 4.5 to 5 cm. wide, the principal nerves about 5 pairs; panicle condensed, oblong, 6 cm. long, 1 cm. wide, staminate

[1] Received March 15, 1927.

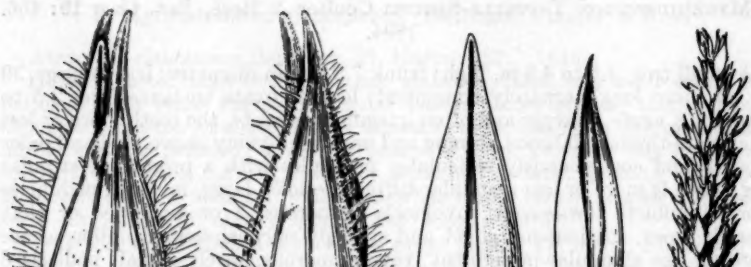

Fig. 1.—*Olyra Sampaiana*, 2 views of pistillate spikelet, fruit, and staminate spikelet, × 10 dia.: panicle, nat. size.

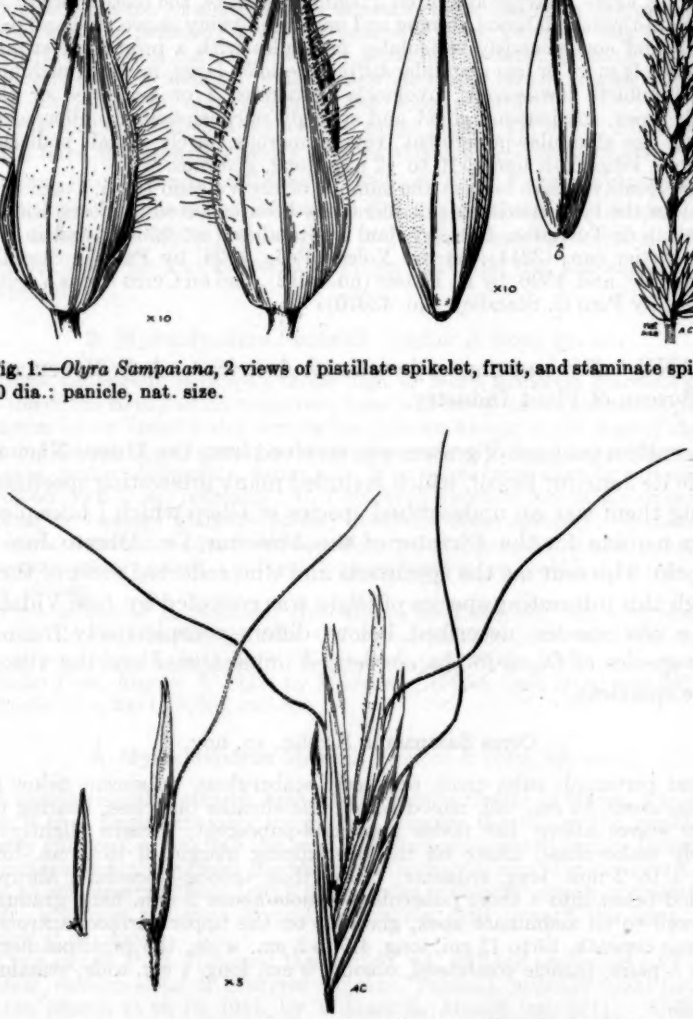

Fig. 2.—*Trisetum bulbosum*, spikelet, floret, and palea, × 5 dia.

below, pistillate above, interrupted between, the staminate portion about 1 cm. long; staminate spikelets narrow, about 4 mm. long, acuminate; pistillate spikelets about 2.5 mm. wide, the glume and sterile lemma about equal, 7 mm. long, tawny, rather thick and firm, 5-nerved, the outer nerves forming a thickened margin, the glume minutely pubescent, with a conspicuous fringe of hairs near the margin and somewhat short-villous on the back below, the sterile lemma similar but less villous and with scant marginal hairs; fruit narrow, 6 mm. long, 1.7 mm. wide, acuminate, with a blunt tip, laterally compressed at base, glabrous, dull white or tawny, under a lens very obscurely pitted, the margins nearly meeting over the palea along the upper part.

Type in the United States National Herbarium, no. 1,297,351, collected at Reeve, State of Espirito Santo, Brazil, December 6, 1924, by José Vidal (no. 44). I have seen no other specimen.

The Grass Herbarium recently received a package of Chilean grasses from Brother Claude Joseph who has sent many plants from Chile to the United States National Herbarium. In this package was the specimen of *Trisetum* which is described below as a new species.

Trisetum bulbosum Hitchc., sp. nov.

Perennial; culms erect, glabrous, 30 to 50 cm. tall, the base thickened to a bulb 3 to 6 mm. thick; sheaths glabrous; ligule thin, rounded and lacerate, 1 to 2 mm. long, decurrent; blades glabrous, scaberulous, flat, becoming somewhat involute or folded, mostly not more than 5 cm. long, the 4 to 6 cauline ones gradually shorter, 0.5 to 1.5 mm. wide; panicle narrow, almost spikelike, 8 to 10 cm. long, pale, the branches appressed, the axis and branches scabrous; spikelets narrow, about 1 cm. long, mostly 3-flowered, the rachilla prolonged as a small bristle, the third floret smaller than the others; glumes narrow, the first 6 to 7 mm. long, 1 to 3-nerved, the second a little wider and a little longer (about 1 mm.) than the first, 3 to 5-nerved; first lemma narrow, about 1 cm. long, rather obscurely 3-nerved, minutely scaberulous below, the callus antrorsely pubescent, 0.5 mm. long (being the first rachilla-joint disarticulating at the base), the upper half scarious, the apex divided into two delicate pointed teeth 1 mm. long, the awn emitted from about the middle of the back, 12 to 15 mm. long, geniculate, flexuous; palea small and narrow, about half as long as the lemma, finely ciliate on the nerves; second lemma similar to the first but a little smaller, the callus slender, sharp-pointed, about 2 mm. long, antrorsely pilose (consisting of the second joint of the rachilla disarticulating near the base), the short pilose base of the next rachilla joint remaining behind the palea; anthers 2 mm. long.

Type in the United States National Herbarium, no. 1,297,352, collected at Concepción (San Pedro), Chile, October 30, 1926, by Brother Claude Joseph (no. 4607). I have seen no other specimen.

This species is easily distinguished by the small bulbs at the base of the culm. It differs from other species of *Trisetum* in the disarticulation of the rachilla. Usually, in this and allied genera, the rachilla disarticulates at the summit of the joint or internode thus leaving only a short callus at the base of the floret, the rachilla-joint above being persistent along the back of the palea. In *Trisetum bulbosum* the disarticulation takes place at the base of the joint, leaving the joint above as a long sharp callus projecting below the floret.

BOTANY.—*New genera and species of Ivory Palms from Colombia, Ecuador and Peru.*[1]

O. F. COOK, Bureau of Plant Industry.

The "vegetable ivory" palms of South America are a neglected and little known group, peculiar in many floral characters as well as in the large size and solid texture of the endosperm. Eminent botanical authorities of the last century did not recognize *Phytelephas* as a true palm, but associated it with *Cyclanthus*, *Pandanus* or *Nipa*, or set it apart as an "anomalous genus." The relations with other American palms were not appreciated.[2]

The ivory palms are notably tolerant of shade and are adapted to undergrowth conditions of the darkest and dampest forests, but can live in the open if provided with sufficient moisture. Although the nuts are exported in large quantities from Ecuador, Colombia, and Panama, the palms are confined to the virgin forests which generally are remote from inhabited places and difficult of access, so that little botanical material has been collected and knowledge of the plant characters has remained fragmentary. Hundreds of sheets of other palms accumulated in the U. S. National Herbarium, but *Phytelephas* was represented only by a few fruits and nuts until leaves and inflorescences were collected in Panama by H. Pittier, a few years ago.

Thus far only the genus *Phytelephas* has been recognized in the ivory palm group, extending from Panama to Bolivia and including several species. A new genus from the west coast of Colombia has characters very different from *Phytelephas*, and is not less divergent from other palms. Two other genera need to be separated from *Phytelephas*, one in Peru and another in Ecuador.

Outstanding features of the new type from Colombia are a ramose male inflorescence and an expansion of the receptacles of the male flowers into large bodies, capitate and variously deformed by pressure, instead of the simple inflorescence and flat patelliform receptacles of *Phytelephas*. The stamens are minute and have the appearance of small grains of sand scattered over the surface of the receptacles, thus suggesting the generic name *Ammandra*. The filaments and anthers are very short, in contrast with the very long filaments and anthers of *Phytelephas*. The male inflorescence as a whole, forming a relatively

[1] Received March 16, 1927.

[2] COOK, O. F., *Relationships of the Ivory Palms*, Contr. U. S. Nat. Herb. **13**: 133. 1910. *Ivory Palms in Panama*, This JOURNAL **3**: 133. 1913. *Relationships of the False Date Palm of the Florida Keys, with a Synoptical Key to the American Families of Palms.* Contr. U. S. Nat. Herb. **16**: 243. 1913.

short, closely ramified cluster of receptacles, suggests a sponge, a coral or a fungus, rather than a floral structure.

The plant has no trunk, but forms a circle of leaves on long slender leaf-sheaths and petioles, like a tall, graceful fern. The sheaths and petioles are nearly erect and the leaf-blades ascending, though the outer leaves become more divergent, with the pinnae horizontal or eventually somewhat drooping. The reduction of the terminal pinnae is carried further than usual, the last pinnae being only a few centimeters long. The lower pinnae are widely spaced and very narrow, but not shorter than those above. The total length of the leaf, from the base of the sheath to the tip of the blade, is more than 6 meters. The leaf-sheath bundle holds a mass of fibers and fallen leaves that conceal the inflorescences, so that the general appearance of the plants is not altered at the fruiting stage.

The leaves are very different from those of *Phytelephas* in having very long sheaths and petioles, the margins of the sheaths resolved into long simple fibers. The prolonged upper portion of the sheath is shaped like the petiole, nearly round in cross-section. In *Phytelephas* the leaf-sheaths are relatively short and the petiole lacking or very short, that is, with no interval of naked stalk between the sheath and the lowest pinnae. An elongate petiole has been reported by Spruce in a species of *Phytelephas* from eastern Peru, but with trunk and fruit characters which show that it is different from *Ammandra* as well as from *Phytelephas*. Contrasting characters of the four genera now recognized are stated in the following analytical key.

Analytical Key to Genera of Phytelephantaceae

Palms with slender trunks and few leaves; fruits with a fleshy rind and a soft edible pulp: Genus **Yarina,** type species *Yarina microcarpa* (Ruiz and Pavon), from eastern Peru.

Palms with stout trunks or rootstocks and numerous large leaves 6 to 8 meters long; fruits with a hard shell armed with large woody spines and lined with stiff fibers.....

Male flowers represented by large capitate-angular receptacles rather sparingly beset with minute stamens, the anthers and filaments both very short; leaves with long slender sheaths and petioles: Genus **Ammandra,** type species *Ammandra decasperma* Cook, from Colombia.

Male flowers with flat patelliform receptacles closely crowded with the filaments of the large stamens, the anthers and filaments both very long; leaves with short sheaths; petioles very short or wanting.....

Male flowers sessile or on very short pedicels, forming a continuous covering of the spadix; stamens 36 to about 200, in a close tuft or tassel; leaves with pinnae regularly spaced along the rachis: Genus **Phytelephas,** type species *Phytelephas macrocarpa* Ruiz and Pavon, from eastern Peru.

Male flowers on slender tapering pedicels 4 to 6 cm. long; stamens more than 1,000 forming large spherical heads 2 to 3 cm. in diameter; leaves with pinnae aggregated in groups: Genus **Palandra**, type species *Palandra aequatorialis* (Spruce), from Ecuador.

Ammandra Cook, new genus

Palms related to *Phytelephas*, with large spiny fruits in dense heads, but the male inflorescence short and ramose, and the male flowers represented by angular woody receptacles with very small, short stamens scattered over the surface. Plants trunkless, with slender pinnate leaves on long cylindrical petioles, the leaf-sheaths resolved, except on the petiole side, into a loose network of long slender straight fibers like horse-hairs; pinnae less than 50, mostly opposite, regularly spaced, the terminal and subterminal much reduced; texture thin and papery, smooth on both surfaces, below with prominent submarginal veins. Male inflorescence with two spathes, the outer short, ensiform, the inner complete, fusiform or ovate, of rather thin texture, with narrow lateral carinae. Peduncle rather slender, somewhat compressed, with several large bracts below the flowering portion; axis strongly flattened with numerous short branches forming clusters of oblong, cylindrical or irregularly compressed woody receptacles representing the male flowers; stamens very small with short oblong anthers borne on very short filaments so that the anthers appear sessile on the surface of the receptacles. Female inflorescence and fruits similar to those of *Phytelephas*, rough with pyramidal spines, but with fewer fruits in a cluster, larger numbers of seeds in the fruits, the seeds strongly compressed, the hilum at the base of the seed, instead of on the inner or mesial face as in *Phytelephas*, the endocarp and testa thinner, the endosperm grooved by the branches of the raphe, the embryo short and broad, subdorsal, remote from the hilum.

Ammandra decasperma Cook, new species

A trunkless palm with an extremely short axis, the insertions of the leaves not separated by any lengthening of the internodes, also the leaf-bases extremely thin and closely compressed at the ring of attachment. Leaves about 10 or 12, attaining a length of 6 meters, with long slender sheaths and petioles, a relatively short rachis, and less than 50 pairs of pinnae, usually opposite, with remarkably exact placement.

Leaf-sheaths attaining 120 cm., measured to the ends of the vertical grooves marking the attachment of the fibers; the sheath-tissues remaining alive only on the petiole side, not persisting in the form of plates or sheets of dry material, but soon resolved into slender straight fibers, with very slight connection into a network; base of sheath of indurated texture, only 2 or 3 mm. thick at the attachment to the axis, the surface a peculiar gray-drab color, becoming greenish about 60 cm. above the base; living portion of sheath at 20 cm. from the base 4 cm. wide and about 2.5 cm. thick, retaining this thickness upward; inner face of sheath concave or flat for about 90 cm. from base, then becoming convex; upper part of the sheath like the petiole in color, texture and shape, becoming nearly round and merging gradually into the petiole, marked on the inner face by the narrow lines of attachment of the fibers, about 1 cm. apart; cut surfaces of sheath and petiole showing scattered dark brown or black fibers. Petioles erect, attaining 3 meters, about 2 cm. wide at base, nearly cylindrical, slightly thicker than wide. Rachis 259 to 264 cm. long, blade 269 cm. long; rachis sharply angled above, flat underneath, triangular

in section. Pinnae 45 to 47 on each side, the lowest very narrow, the middle lanceolate; the terminal very short; texture rather thin, smooth and naked on both sides, somewhat paler beneath, with strong submarginal veins 2 to 4 mm. from the margin, prominent below and forming a sharp ridge firmer than the margin; two other large veins between the submarginal and the midrib, but not prominent; lowest pinna on one side of leaf 40 cm. by 3 mm., on other side 49.5 by 8 mm.; second and third pinnae respectively 63 cm. by 2 cm. and 64 cm. by 3.5 cm.; pinna from middle of leaf 60 cm. by 5.3 cm.; tenth pinna from the end 37 cm. by 2.6 cm.; subterminal pinna 16 cm. by 1.5 cm.; terminal 11 cm. by 1 cm.; or the narrowly margined percurrent rachis may be considered as a terminal pinna, 9 cm. long by 3 mm. wide.

Male inflorescence: outer spathe, incomplete, 4.5 cm. wide at 10 cm. from the end, the terminal portion ensiform, flattened, carinate, splitting about 6 cm. from the end on each side; texture very firm and tough, the surface gray-drab like the base of the leaf-sheaths; inner spathe 37 cm. long, 3 cm. wide at base, widened gradually to 4 cm. and then more abruptly, about 6 cm. wide at 10 cm. from the end, splitting for about 20 cm.; a distinct narrow carina on each side, the texture thin, rather stiff and papery when dry, the surface even, not plicate or fissured as in *Attalea*. Peduncle with 5 large bracts or rudimentary spathes below the first flowers; length of peduncle to first bract 35 cm., to first flower 49 cm., the first bract 5 cm. long, the others shorter; peduncle 2.5 cm. wide at base, 1.8 cm. thick. Flowering axis about 30 cm. long strongly compressed, 3 cm. wide, 1 cm. or less in thickness, with the heads of flowers forming a dense mass 8 to 10 cm. wide, gradually tapering to the end; some of the lower flower clusters 2 to 3 cm. apart, the others more compact; the heads of flowers with pedicels 1 to 2 cm. long, the heads 3 cm. long including the pedicels, and 3 cm. broad, each head composed of 6 to 9 broadly angular or variously compressed individual receptacles 1 to 1.5 cm. long and wide, often with distinct stalks 5 mm. long and wide; the heads rusty brown in color with pale yellowish stamens sprinkled rather sparsely over the surface, the individual stamens usually well separated, seldom in contact.

Female inflorescence seen only in fruiting stage, about 20 cm. long, with the fruits 30 cm., at base 2.5 cm. wide; basal joint 1.5 cm. long, to insertion of first spathe, notched at the sides; spathe 18 cm. long, 3 cm. wide, ensiform with a rather broad tip, open on one side for about half the length; lateral carinae thin, about 5 mm. wide; second joint of spadix about 8 cm. long; second spathe 15 cm. long, about 4 cm. wide, the lateral carinae reduced to fine ridges; peduncle between upper spathe and fruit head 6 to 8 cm. long, 2.5 cm. wide at base, 4 cm. at end, 2 cm. thick in upper part, the surface smooth, not marked with bract-scars, but close to the end showing two complete rings of united bases of bracts or small spathes; fruits subtended by a bract about 2 cm. wide and by a persistent perianth; sepals 4, petals 5 or 6, the petals somewhat narrower than the sepals, 6 to 7 mm. wide, probably about 5 cm. long. Fruit-cluster smaller than in *Phytelephas*, the 3 to 5 fruits 9 cm. to 13 cm. in diameter, armed with coarse woody spines and persistent woody styles 1 to 3 cm. long; exocarp fibers short and close; mesocarp fibers fine and rather sparse; with a thin tight-fitting, fibrous sac of tough flexible texture inclosing each seed; such sacs not present or only slightly indicated in *Phytelephas*. Seeds 7 to 10, strongly compressed and flat-sided, 4.5 to 5 cm. long, 3 to 4 cm. broad, 2.2 to 3 cm. thick, often narrowly wedge-shaped or flattened, the inner margin nearly straight, with a sharp or somewhat prominent lower corner, at the adhilum; surface of seeds smooth and even, black, without the layer of closely

adherent whitish material surrounding the seeds of *Phytelephas;* hilum basal, rather large and prominent, attaining 2 cm. by nearly 1.5 cm., coarsely pitted, but with outer coat of hard, brittle, dark brown tissue.

The type specimens, with male and female inflorescences, were collected at Buenaventura Colombia by O. F. Cook and F. C. Baker (no. 153) May 26, 1926, and have been deposited in the U. S. National Herbarium, under numbers 1,282,066, 1,282,067, 1,282,068, 1,282,069, 1,282,070, 1,282,071.

Buenaventura is noted for its heavy and nearly continuous rainfall. The surrounding country is a network of tidal inlets, swamps, and small hilly islands, often with steep or precipitous shores, scoured by strong tidal currents. *Ammandra* grows in abundance on the wooded islets across the river from the town. Like other ivory palms, it is an undergrowth plant of the deep forests.

A port has been constructed at Buenaventura and a railroad to the interior, but in many places the forests have not been cut, and the palm flora is still intact. Of 13 groups of American palms that have been recognized as families, at least 9 are represented at Buenaventura, only the Ceroxylaceae, Pseudophoenicaceae, Malortieaceae, and Chamaedoreaceae being absent. Among the genera represented are *Bactris, Attalea, Scheelea, Guilielma, Manicaria, Geonoma, Welfia, Oenocarpus, Catostigma, Synechanthus, Mauritia,* and *Acanthorhiza.* Several genera, such as *Astrocaryum, Acrocomia, Pyrenoglyphis, Elaeis,* and *Raphia,* which occur on the Isthmus of Panama were not seen at Buenaventura.

Two other trunkless palms, an *Attalea* and a *Scheelea,* grow in the same forests, but *Ammandra* has smaller and more slender leaves, with no tendency to grouping of the pinnae or to adherence of the upper pinnae to form a solid terminal section of the leaf, which are features of the cocoid genera. Special leaf characters of *Ammandra* are the strong submarginal veins of the pinnae and the great reduction of the terminal pinnae. Most of the pinnae are arranged in opposite pairs, especially in the middle and upper part of the leaf, but the narrow lower pinnae may be alternate or somewhat irregular.

The flowering season of *Ammandra* probably occurs in December. At the end of May it appeared that no flowers or fruits were obtainable, though hundreds of individuals were examined in the hope of identifying the strange palm. Finally, at the close of our last visit to the forest, two fruiting individuals were found and a single male inflorescence was brought in by our native guide. Further search was forbidden by the danger of being stranded above the tangled passages of a narrow tidal creek.

While the inflorescence was drying on board the steamer, many beetles emerged. Specimens have been deposited in the U. S. National Museum, including two species of weevils, a Scarabeid, a Hydrophilid, and six species of Staphylinidae.

The native name of the Ammandra palm at Buenaventura is *"cabecita,"* meaning "little head," doubtless with reference to the smaller size of the fruit clusters, in comparison with *Phytelephas.* The nuts are not collected or

exported, being smaller in size and the endosperm possibly not so hard as in *Phytelephas*, which apparently does not occur in the immediate vicinity of Buenaventura. According to local information the nearest locality for the true "tagua" is on the Dagua River several hours by canoe from Buenaventura.

Yarina Cook, new genus

Ivory palms from eastern Peru with petiolate leaves as in *Ammandra*, but borne on a slender ascending trunk marked with deep areolate leaf-scars arranged in spirals. The leaves are few and the petioles shorter than in *Ammandra*, the pinnae more numerous and shorter, and the lower pinnae much reduced. The fruits are fleshy and edible, including the outer rind, which in *Ammandra* and *Phytelephas* forms a hard shell armed with large woody spines and with an inner lining of stiff fibers.

The only ivory palm previously described with petiolate leaves is a species that grows in the eastern Andes of Peru, named by Ruiz and Pavon in 1798, though still but little known. The presence of a petiole suggests an association with *Ammandra*, but an assignment to that genus is not warranted in view of several differences recorded by Spruce and shown in the photograph included by Wallace in Spruce's "Notes of a Botanist on the Amazon and Andes."

Yarina microcarpa (Ruiz and Pavon) Cook

Phytelephas microcarpa Ruiz and Pavon, Syst. Veg. Peruv. **1**: 302. 1798. SPRUCE, Journ. Proc. Linn. Soc. Bot. **11**: 176. 1871. Notes of a Botanist on the Amazon and Andes, **2**: 133, *f. 6*. 1908.

The photograph is said to have been taken on the river Ucayali in eastern Peru and shows a small slender palm with only 6 or 7 leaves, the pinnae widely spaced and spreading, horizontal in the middle of the leaf, retrorse in the lower part, and apparently with much shorter petioles and sheaths than in *Ammandra*. The lower pinnae are much shorter, and go down nearly to the point of divergence of the leaf bases, so that the petioles may not be more than one or two feet long, instead of 7 or 8 feet as in *Ammandra*. The number of pinnae probably is between 60 and 70. The characters of the inflorescences and flowers are still entirely unknown, and should receive the attention of botanists who visit the eastern Andes.

Spruce saw the palm in many places along the Huallaga River, and the original localities mentioned by Ruiz and Pavon were between the Ucayali and the Huallaga. The type species of *Phytelephas*, *P. macrocarpa*, also grows in the same region and is described by Spruce as having "no proper petiole at all," in comparison with a "long petiole" in *P. microcarpa*. The trunk and fruit characters are also definitely contrasted, *P. macrocarpa* with "either no trunk at all, or a very short and stout one, which is nearly always inclined or crooked," while in *P. microcarpa* "well-grown plants have a slender inclined stem no thicker than the arm, reaching 10 feet high, and spirally areolate with the deep leaf-scars. The fruits are about the size of a child's head, and so much resemble externally the fruits of some anonas, that the Peruvians call them 'Anon de Palma,' but the palm itself it called 'Yarina.'" The

fruits of *P. macrocarpa* "are 9 to 12 inches in diameter, nearly spherical, and consist of from 12 to 20 closely packed capitula. . . . ."

The native name *yarina* affords a convenient generic designation. As a word of the Quichua language *yarina*, or *yaurina*, is supposed to mean fish-hook or fish-bait, and may allude to a use of the hard nuts to make fish-hooks. Also the edible fruit pulp might be used as bait, or in catching fish with poison.

Genus PHYTELEPHAS Ruiz and Pavon

Ivory palms with stout trunks, usually short and decumbent, but in some species ascending or erect, with very short internodes. Leaves numerous and large, pinnae 80 to 100 pairs equally spaced on the rachis, with little or no petiole; male inflorescence emerging from the two spathes as a long simple spike or catkin densely crowded with sessile or subsessile male flowers, each flower a compact tassel-like cluster of large stamens, both filaments and anthers long and slender; female inflorescence very short, the cluster of large female flowers surrounded by an involucre of large bracts; fruits very large and woody, with 4 to 7 large triangular wedge-shaped nuts; and hilum near the middle of the inner angle of the nut, the embryo basal, narrower and longer than in *Ammandra*.

The type species is *Phytelephas macrocarpa* Ruiz and Pavon, from eastern Peru. Characters of this species as reported by Spruce are noted under *Yarina microcarpa*, *Phytelephas Seemanni*, and *P. karsteni*.

Phytelephas tumacana Cook, new species

Trunk erect attaining 6 meters or more, 20 cm. in diameter, with very short internodes, the angles of the leaf-bases persistent, forming close spirals; similar to the trunk of *Manicaria*, but the internodes still shorter. Leaves attaining 6 to 7 meters on young palms, on mature individuals about 5 meters; petioles short, 2 to 10 cm. long, 4.5 cm. wide, 2.5 cm. thick; rachis 5 meters; long, triangular in cross section with a broad, low, gradually sloping median ridge, the under surface deep green, mottled with grayish-brown scale material, very closely appressed. Pinnae about 100 on each side, 102 counted; first pinna 12 cm. by 1 cm., sometimes only 4 or 5 cm. long; second and third pinnae scarcely larger than first, fifth pinna 19 cm. by 1.5 cm., tenth pinna 28 cm. by 2 cm. with rachis 2.5 wide; middle pinnae attaining 94 cm. by 5.5 cm.; tenth pinna from the end 54 cm. by 3.5 cm.; fifth from end 43.5 cm. by 3 cm., subterminal pinnae 44 cm. by 1.5 cm.; terminal pinnae 20 by 1.5, sometimes symmetrical, with the percurrent rachis as midrib, but other leaves with a terminal split; midrib of pinnae prominent above and below; other veins prominent below but not above.

Male inflorescence: Outer spathe exposed 23 cm. above ground, 5.5 cm. wide, including thin lateral carinae 6 to 7 mm. wide; inner spathe 37 cm. long, probably about 5 cm. wide, in dry state 4 cm. between the carinae, which are much smaller than those of the outer spathe; peduncle from spathe to first flower 11 to 12 cm., the spathe decurrent on the sides, higher in the middle; flowering axis 50 cm. long, but probably not fully extended, the terminal portion with the flowers still very crowded; width of axis in the lower part 2.5 cm., with the flower masses 4 cm.; axis near the middle 2 cm. wide and 1 cm. thick, distinctly compressed; lowest bract 2 cm. long, subtending 3

flowers in a group; other bracts gradually reduced, V-shaped, with a short narrow rim running up on each side of the cluster; the lower groups of flowers with separate pedicels 3 to 4 mm. long, 2 mm. wide; pedicels farther up irregular, united and reduced in length, the number irregular and difficult to determine, but many of the groups with four flowers and some with five; upper pedicels reduced to about 1 mm., in some cases all the flowers of a cluster seem to be completely fused, forming larger heads with dense masses of stamens 1.5 cm. long, or nearly 2 cm. long on some of the lower and more mature flowers. Stamens with brown filaments, becoming rather tough and elastic while drying; the anthers light yellow when fresh. Sepals and petals apparently represented by several small scale-like organs along the upper margins of the pedicels.

Female inflorescence seen only in fruiting stage; peduncle between the upper spathe scar and the fruit head 14 cm. long, 3.5 cm. wide, 2 cm. thick, marked in the upper half by numerous transverse or oblique bract-scars, 2 to 4 cm. wide, becoming closer and broader above, forming 2 or 3 complete collars at the end. Fruit cluster round, about 25 cm. in diameter, of 11 to 12 fruits, fitted compactly together, the fruits 10 cm. long, 14 cm. broad, with 4 to 6 nuts in each fruit, the normal number apparently 6, the fruits with 4 and 5 nuts appearing abnormal and unsymmetrical. Attachment of fruits 2.5 to 3 cm. long, 1.5 cm. wide, leaving a prominent rounded receptacle beset with short fibers; persistent styles and stigmas of fruits 13 cm. long, united for about half the length, then with branches separating rather irregularly, usually six, probably indicating the number of carpels, the tube of the style usually open on one side showing 12 longitudinal ridges or fibers, each pair of fibers probably representing a division of the stigma; texture of the persistent styles, stigmas and petals tough and horny, becoming brittle with age.

Specimens and photographs were obtained from palms growing at Tumaco, Colombia, some in a park and others in door-yards, said to be grown from seeds or plants brought from the adjacent mainland. The specimens and measurements of the leaves were from a large female palm with a trunk about 3 meters high bearing many large clusters of fruits. Type material is deposited in the U. S. National Herbarium under numbers 1,282,072, 1,282,073, 1,282,074, 1,282,075, 1,282,076, 1,282,077, collected at Tumaco, Colombia, May 10, 1926, by O. F. Cook and F. C. Baker (no. 103).

The leaves of *Phytelephas* are used extensively at Tumaco for thatching houses. The thatch material is called *cade*, while the nuts are called *tagua*. Spruce gives *cadi* as the name of *Phytelephas aequatorialis* in Ecuador. No doubt *cade* or *cadi* are equivalents of *kata*, which is a word for roof in the Quichua language of Peru, with *katani* and *katakuni* as verbs meaning to thatch. The wide distribution of Quichua plant names and place names in South America is remarkable. The word *tagua* or *tahua* in Quichua is the numeral four and may allude to the four nuts in each fruit, in the Peruvian species of *Phytelephas*. The name *polo ponto* or *pulu puntu*, recorded by Spruce for *Phytelephas macrocarpa* in the Eastern Andes, may be equivalent to *puillu puitu*, (Middendorff 665), meaning in Quichua a square of four-parted knot, that would aptly describe the fruit. The word *anta*, recorded by Seemann as the native name of *Phytelephas* in the Cupica district in the northwestern part of Colombia, means *metal* or *copper* in Quichua, and might

refer to the hardness of the seeds. Also the word *chili* is given (Holguin 83) as the name of the "tree that produces the vegetable ivory (corozo)."

The young male inflorescences are eaten at Tumaco, as soon as they begin to emerge from the spathe, when a rapid growth or expansion is taking place and the tissues are still soft. During the process of drying the surfaces of the peduncle and axis have a moist appearance like cured vanilla beans, as though an oily substance were being formed by fermentation. There is a strong and rather pungent odor, not unpleasant, suggesting bitter almonds.

PHYTELEPHAS SEEMANNI Cook

Phytelephas macrocarpa Seemann, Botany of the Herald, 205, pl. 45–47. 1852–57. Not *Phytelephas macrocarpa* Ruiz and Pavon Syst. Veg. Peruv. **1**: 301. 1798. *Phytelephas seemanni* Cook, U. S. Dept. Agric. Bur. Pl. Ind. Bull. **242**: 68. 1912.

"As already recognized by Spruce as far back as 1869, the name *Phytelephas macrocarpa* does not belong to the vegetable-ivory palm described by Seemann from Panama (Botany of the *Herald*, 1852–1857, pls. 45–47, p. 205). Two species, *macrocarpa* and *microcarpa*, both from the eastern slopes of the Andes of Peru, were named by Ruiz and Pavon in connection with the original description of the genus *Phytelephas*, but without distinctive characters other than the size of the fruits. Seemann did not know the Peruvian species, but was aware that the Panama palm was different from another *Phytelephas* found by Purdie in the upper valley of the Magdalena River in Colombia, supposed by Karsten to represent *Phytelephas microcarpa*. Spruce's account of the true *P. macrocarpa* of Peru leaves no doubt that the Panama species is entirely distinct. It has the trunk decumbent and creeping instead of upright, the leaves with fewer, larger pinnae, the spathes two instead of three or four, the male flowers with 36 stamens instead of 150 to 280. The fruits also are larger and contain more numerous nuts, but with fewer fruits in a head."[3]

The preceding note was published in relation to a shipment of seeds from Panama, but is somewhat misleading. The original locality of Seemann's palm at Cupica is not in Panama territory, but it was supposed that ivory palms from Panama would represent the same species. Later it was found that palms from several districts in Panama were different and five of the local types were named as new species.[4]

The palm described and illustrated by Seemann differs from the Panama species in having the surface of the fruits divided into larger areas, with coarser spines and a stronger development of fibers in the cortex and mesocarp. A fruit specimen in the collection of the Department of Agriculture agrees closely with Seemann's description and drawings.

Spruce's description of *Phytelephas macrocarpa* states that the trunk is very short and inclined or decumbent, while the trunk of *P. seemanni* grows

[3] U. S. Dept. Agr., Bur. Pl. Ind. Bull. 242. Seeds and Plants Imported During the Period from April 1 to June 30, 1911, p. 68, No. 31115. Issued May 31, 1912.

[4] *Ivory Palms in Panama*. This JOURNAL **3**: 138–143. 1913.

to 20 feet long, though rising not more than 6 feet from the ground. The leaves of *P. macrocarpa* have about 100 pairs of pinnae, attaining 32 inches 1½ inches, while *P. seemanni* is credited with about 80 pinnae, 3 feet long and 2 inches broad. The fruits of *P. macrocarpa* usually ripen only 4 seeds, those of *P. seemanni* 6 to 9 seeds, "but generally 7." The smaller number of stamens, 36, and the larger number of spathes, 4 or 5, are characters of *P. seemanni*. The so-called spathes may represent large bracts at the base of the female inflorescence, but in that case the large size and small number of the bracts would be distinctive of the species.

Phytelephas karsteni Cook new species

Phytelephas microcarpa Karsten, Florae Columbiae Sp. Sel. **1**: 165 t. 82. 1861. Spruce, Journ. Proc. Linn. Soc. Bot. **11**: 178. 1871. Not *Phytelephas microcarpa* Ruiz & Pavon, Syst. Veg. Peruv. **1**: 302. 1798

Another ivory palm was described by Karsten from the valley of the Magdalena River, Colombia, with no trunk and the fruits usually with only 4 seeds. As recognized by Spruce, this species is distinct from *Yarina microcarpa* in the absence of a distinct petiole as well as in the characters of the fruit. Karsten's palm evidently is more closely related to the other Peruvian species, *P. macrocarpa*, which likewise has a 4-seeded fruit with a fleshy pulp and female flowers of nearly the same size. Spruce says that there are 4 or 6 stigmas in *P. macrocarpa*, though only about 4 of the carpels are fertile, while Karsten's figures show only 4 stigmas. The entire female flowers of *P. karsteni* are 9 cm. long, according to the natural-size figures, while the flowers of *P. tumacana* must have been about 13 cm. long. The styles and stigmas together are about 10 cm. long in *P. macrocarpa*, while in *P. karsteni* they are 8 cm. long. The stamens of *P. macrocarpa* are about 1.2 cm. long, those of *P. karsteni* 1.5 cm. Karsten's figures of the female inflorescence show an involucre of many ovate-acuminate broadly overlapping bracts, about 9 cm. by 4 cm. The insertions of such bracts are indicated as prominent transverse ridges on the axis of the adult inflorescence. Spruce describes *P. macrocarpa* as having an involucre of many small subtriangular scales around the base of the fruit-heads, with the tips of the scales separating into fibers when the fruit is mature.

Phytelephas longiflora Cook, new species

Female inflorescence with an involucre of many large bracts arranged in several longitudinal rows, probably in 8 rows, with 7 bracts in each row, the lower bracts larger and very broad, the middle smaller, the upper, subtending the flowers, much larger, triangular, about 8 cm. long and 3 cm. broad; female flowers attaining nearly 20 cm.; sepals narrowly triangular, 7 to 9 cm. long by 1 to 1.3 cm. broad; petals narrowly lanceolate, light colored, 15 to 16 cm. long by 1.5 cm. broad; staminodes numerous, slender, 3 cm. long; pistil about 18 cm. long, the ovary 1 cm. long by 1.2 cm. broad, the style nearly 11 cm. long by 2 mm. thick, the stigmas 5, about 6 cm. long, about 1 mm. thick.

Specimens and photographs of the inflorescence were obtained in February, 1913, by H. Pittier (no. 5867) from a palm in a public park at Caracas, Venezuela, of unknown origin, but probably from the western part of Venezuela.

The description and measurements are taken from photographs of a female inflorescence and of dissected female flowers in fresh conditions, the flower photographs in natural size. The specimens are not now accessible, but copies of the photographs have been deposited in the National Herbarium as representing the type material.

The very large flowers and the involucre of numerous bracts arranged in longitudinal rows are striking features. There is no indication of such an involucre in any of the descriptions of other species, or in the specimens that have been compared. The bracts of *P. karsteni* are much larger, and broader above the base, instead of being triangular. The bract scars of *P. tumacana* are fewer and broader, and are scattered over the upper half of the last joint of the spadix, instead of being arranged in close series.

Palandra Cook, new genus

Ivory palms related to *Phytelephas*, with an erect columnar trunk, attaining a height of 5 to 10 meters, roughened with prominent broadly triangular leaf-scars, covering the longer side of the short, oblique internodes. Leaves numerous and large, with more than 100 pinnae on a side, inserted in groups of 3 to 5. Male inflorescences forming a broad loose spike, the very large male flowers borne on long slender pedicels inserted on the axis in groups. Stamens long and slender as in *Phytelephas*, but more numerous, exceeding 1,000, forming a large spherical head, in striking contrast with the sessile, crowded, tassel-like male flower of *Phytelephas*. Female inflorescence similar to that of *Phytelephas*, the fruits armed with very large conical spines, the nuts rather narrow and oblong, the hilum sub-basal, rather small and very prominent, or raised on a projecting rim of the shell and with the adhilum forming a distinct point or projecting spine. Seedling with a long burrowing cotyledon and two bladeless sheaths, the second very long, the first leaf compound with numerous pinnae, as in *Phytelephas*.

The type species is *Palandra aequatorialis* (Spruce), described originally from the plain of Guayaquil but supposed to extend northward into Colombia. It is the largest of the ivory palms, with a tall trunk and grouped pinnae that give it a distinct habit.

The Tumaco ivory palm, on account of its erect trunk, was supposed at first to represent the species that Spruce had discovered in Ecuador, but it was clear from Spruce's description that the male inflorescence was unlike that of *Phytelephas*, and different also from *Ammandra*. Spruce's account of the floral characters is confirmed by a series of specimens and photographs obtained near Huigra, Ecuador, October 23, 1918, by Dr. J. N. Rose, no. 22585. Several characters not given by Spruce are supplied from these specimens. The U. S. National Herbarium also has a specimen from Balao, Ecuador, Eggers no. 14701, from the herbarium of Captain John Donnell Smith. The specimens of *Palandra* from Huigra are accompanied by two fruit heads which have small external spines and broad nuts with a very large mesial hilum. The occurrence of a species of *Phytelephas* in the same locality as *Palandra* is suggested.

The specimens of *Palandra* show sections of the male inflorescence with the very large male flowers borne on straight, slight tapering pedicels, 4 to 6 cm. long, and 2 to 3 mm. wide in the dry condition. The stamens are long and slender, as in *Phytelephas*, not the short minute stamens of *Ammandra*,

but forming very large heads, 2 to 3 cm. in diameter, consisting of more than a thousand stamens, according to Spruce. The receptacle is not a thickened solid body as in *Ammandra*, but a flat expansion of the end of the pedicel with the margin showing minute rudiments of the floral envelopes, as in *Phytelephas*. The pedicels of the flowers are inserted on the axis in groups which may represent obsolete branches. It is remarkable that the branches have been suppressed while the pedicels have been elongated. Since no other palm has such flowers or such pedicels, *Palandra* forms a strikingly distinct genus. The interrupted or fastigiate pinnae are another unique character among the ivory palms, though a similar specialization appears in several genera of Cocaceae. The grouping of the pinnae on the rachis may have a genetic relation to the grouping of the flowers on the axis of the inflorescence.

Pedicellate flowers evidently were a primitive feature of the Phytelephantaceae, as in the Sabalaceae and Pseudophoenicaceae. Even in the Cocaceae pedicellate flowers are indicated as an ancestral character. Flowers of *Jubaea*, from palms growing at Santa Barbara, California, have pedicels from 2 to 8 mm. long. Although shortened or suppressed in *Phytelephas*, pedicels have been retained in *Ammandra* and greatly enlarged in *Palandra*. In contrast with such retention or increase of the pedicels and receptacles is the elimination of the floral envelopes of the male flowers, which has gone much farther the Phytelephantaceae than in other families of palms. The opposite tendencies are shown in the specializations of the female flowers of the ivory palms, which are not pedicellate and have larger floral envelopes than in any other family.

Palandra aequatorialis (Spruce) Cook

Phytelephas aequatorialis Spruce, Journ. Proc. Linn. Soc. Bot. **11**: 180. 1871.

The palm is described by Spruce as having a stout, usually erect trunk 15 to 20 feet high; leaves 30 feet long with very short petioles; pinnae nearly 2 feet long inserted on the rachis in groups of 3 or 4; male inflorescences exceeding 4 feet in length, emerging from two large spathes; peduncle flattened, 18 inches long, 2 inches wide; male flowers numbering about 170, containing more than 1,000 stamens half an inch long, the filaments longer than the anthers. The male flowers are noted as white on the label of the specimen collected by Eggers. A photograph of "a male tagua palm" with grouped pinnae standing at different angles to the rachis, was published in the Bulletin of the Pan-American Union, August 1913, from Esmeraldas, Ecuador. Another photograph, also from Esmeraldas, shows a female palm with evenly spaced pinnae.

From the specimens and photographs obtained by Dr. Rose it appears that the palms near Huigra attained a height of 12 meters or more with the trunk about 50 cm. in diameter at the base, tapering slightly and gradually upward. The grouping of the pinnae is irregular, sometimes with 5 or 6 pinnae together, and the lower pinnae wider apart than the upper. The number of pinnae appears to be about 120 on a side, on an adult palm with

leaves 5 or 6 meters long. The burrowing cotyledon of the seedling is about 15 cm. long, the first sheath 8 cm., the second sheath 24 to 28 cm. and the first leaf about 70 cm. long, with the sheaths soon resolved into fine simple fibers as in *Ammandra*.

ZOOLOGY.—*The occurrence of* Naobranchia occidentalis *on the Pacific Coast of the United States.*[1] DEOGRACIAS V. VILLADOLID, Stanford University, California (Communicated by DAVID STARR JORDAN).

In April, 1925, I collected specimens of parasitic copepods from the gills of *Parophrys vetulus* (Girard), taken from off Point Reyes, California in water about 50 fathoms deep. The flounder was taken in a "paranzella" net, operated by the trawlers, "Henrietta" and "Three sisters" of the Paladini Fish Company, San Francisco.

In the following June and July I made a trip to Puget Sound in the interest of my flat-fish studies. On July 6, 7, and 8, I was with Captain Fred Weisse of Snohomish, Washington, in his trawler, "Bonita," fishing in Tulalip Harbor, Fort Susan Harbor, and Saratoga Passage, off Whidby Island, San Juan County. During this trip, I collected a number of the same parasites from the gills of *Parophrys vetulus* and *Hippoglossoides elassodon*, both of which are common flounders of Puget Sound. They were all taken by an otter trawl at a depth of about 40 to 60 fathoms. On June 28, 1925, I collected a few of these parasites from the gills of *Platichthys stellatus*, the common flounder of the Pacific Coast of the United States. These flounders were taken from fish traps in Mutiny and Admiralty Bays in water of about 10 fathoms.

The specimens were sent to Professor Charles B. Wilson, of Westfield, Massachusetts, a specialist on the group. To quote Professor Wilson, "The parasites you sent me from the gills of the small flounder, *Parophrys vetulus*, prove to be *Naobranchia occidentalis*, one of the Lernaeopodidae. The only other specimens of this parasite known were five females and one male taken from the gills of the Pacific cod, *Gadus macrocephalus*, at Chignik Bay, Alaska, by the "Albatross." You have thus added a new host and have brought the parasite within the limits of the United States. I will keep the specimens and add them to the collection in the National Museum."

It is of interest to note that *Naobranchia occidentalis* is more common

[1] Received February 12, 1927.

in the northern waters of the Pacific as it approaches its type locality, Chignik Bay, Alaska than in the southern part of its range.

At the present writing, *Naobranchia occidentalis* is known to occur from Point Reyes, California to Chignik Bay, Alaska, in water from 10 to about 50 fathoms deep, from the gills of the Pacific cod (*Gadus macrocephalus*) and three flounders, namely: *Parophrys vetulus* (Girard), the common California "sole" or the sharp-nosed "sole" of Puget Sound; *Platichthys stellatus* (Pallas), the starry flounder; and *Hippoglossoides elassodon* Jordan & Gilbert, the rough-back "sole" or the mud "sole" of the Puget Sound.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE GEOLOGICAL SOCIETY

424TH MEETING

The 424th meeting was held at the Cosmos Club, January 26, 1927, President BUTTS presiding. The Secretary announced the election to active membership of P. D. TRASK and MARIE STADNICHENKO.

Informal communications: O. E. MEINZER called attention to the Seventh Biennial Report of the State Engineer of New Mexico, recently published, which is likely to escape the notice of geologists but which contains five brief papers on ground-water hydrology prepared by members of the Division of Ground Water of the U. S. Geological Survey. These papers are based on investigations that were made possible by appropriations of the State Legislature two years ago. They are as follows:

1. *The Roswell Artesian Basin*, by A. G. Fiedler. This is a preliminary report on one of the most productive artesian basins in the United States, and is based on one of the most thorough and intensive studies of artesian conditions that has ever been made.

2. *The geology and artesian water prospects in the San Jose-Rio Puerco Valley, in Sandoval County*, by B. Coleman Renick. The geologic section includes rocks of pre-Cambrian, Pennsylvania, Permian, Triassic, Jurassic (?), Cretaceous, Tertiary, Pleistocene, and Recent age. Most of the strata are turned up along the western slope of the Nacimiento and San Pedro mountains, forming an artesian structure. Artesian conditions were predicted by Doctor Renick, and have since been demonstrated by test drilling. Thus, this investigation furnishes an example of an artesian basin that was discovered in the course of regular field work by the Geological Survey.

3. *Reconnaissance in Socorro County*, by Kirk Bryan. This brief paper reports the results of a reconnaissance preliminary to a geologic and ground-water survey that is still to be carried out. Shore features of an ancient lake, doubtless of Pleistocene age, were discovered in the San Augustin Plains, in Socorro and Catron counties. At its high stage, this lake reached above the present 6,900-foot contour, was at least 120 feet in maximum depth, and was about 25 miles long and 7 miles wide.

4. *Reconnaissance in DeBaca County*, by Kirk Bryan. This is likewise a brief report on a reconnaissance preliminary to a more thorough investigation.

5. *Geology and ground-water resources of the drainage basin of the Rio Penasco above Hope*, by B. Coleman Renick. The area described lies high up on the east slope of the Sacramento Mountains and is underlain by cavernous limestone of the Chupadera formation (Permian), where the main water table is 500 to 1,000 feet below the surface. The region affords a striking example of perched bodies of ground water. This water is supported by shale strata interbedded with the limestone and gives rise to large springs that furnish irrigation supplies and to one strong flowing well. Attention is called to the possibility of developing additional irrigation supplies from wells and of pumping the wells with water power developed by the pumped water on its way down to the irrigation district.

W. C. ALDEN reported on the condition of the Gros Ventre landslide of June, 1925.

Program: FRANK REEVES: *Thrust faulting adjacent to the Highwood Mountains, Montana.* The Highwood Mountains are one of several isolated mountain groups that rise out of the plains in central Montana. According to Weed and Pirsson, this mountain group consists of an erosional remnant of basaltic and trachyandesitic breccias, tuffs, and lava flows resting on an eroded surface underlain by Upper Cretaceous strata. Both the volcanic debris and underlying Cretaceous strata are cross cut by several stocks and numerous dikes.

Field work by the author in the region during 1926 showed the presence of thrust faults in the upper Cretaceous strata that are exposed on the plains to the north, northeast, and east of the mountains. These thrust faults in general are concentric to the mountain area and in other respects are similar to the thrust faults adjacent to the Bearpaw Mountains. Considerable evidence was obtained during the field work which corroborated the author's earlier expressed belief that the thrust faulting of the region is confined to the upper part of the Colorado shale and overlying formations and that the underlying rocks are neither folded or thrust-faulted. This shallow faulting, together with the fact that the faults are found only in that part of the plains toward which there is a plainsward dip from the mountains, makes it possible to offer the same explanation for these thrust faults as that previously offered for the Bearpaw Mountain faulting—namely, that they are the result of the plainsward slipping, probably on bentonite beds, of the weak upper Cretaceous strata, this slipping being brought about by the load of volcanic material and the earthquake shocks that accompanied the explosive phases of the volcanic eruptions. (*Author's abstract.*)

W. H. BRADLEY: *Tertiary and Recent fresh water algae reefs.* Algae reefs are common in certain parts of the Green River formation of Colorado, Utah, and Wyoming, and assist in interpreting the geologic history of the formation. In order better to interpret these reefs, the recent algal deposits of Green and Canandaigua Lakes, N. Y., have also been studied. Microscopic blue-green and green algae by their photosynthesis precipitate calcium carbonate from the lake waters. If the deposit is formed by one species it usually preserves the form of that plant, but if it is formed by a complex assemblage or felt of algae belonging to several species the deposit has instead a characteristic spongy or arborescent structure. The algal deposits have the form of isolated nodules, hemispherical or turbinate heads, and mammillary beds. Such forms are associated in reefs which may be narrow and fringing, broad, and bed-like, or intermediate between these two depending upon the

shore and bottom profile of the lake in which they formed. Narrow fringing reefs form along steep shores because there the maximum depth at which fresh water algal deposits form rapidly is not far from the strand. Broad bed-like reefs on the other hand form in shallow flat-bottomed bays and the intermediate type on more or less gently sloping bottoms. Most of the algae reefs of the Green River formation are bed-like and range in area from a fraction of an acre to several square miles. They range in thickness from a few inches to about 18 feet. About half of them consist of microcrystalline calcite which has a distinctive spongy or arborescent microstructure and probably were formed by an assemblage of several species of algae most of which were filamentous. Reefs with this microstructure have a variety of megascopic forms none of which is of unusual interest. The remainder of the reefs in the Green River formation were built chiefly by a single alga, *Chlorellopsis coloniata* Reis. This alga also forms reefs in the Miocene lake beds of the Rhine Valley but so far as the writer can determine is elsewhere unknown. Most *Chlorellopsis* reefs are laminated. This lamination is probably annual and in a few reefs is well enough defined to estimate the rate of growth of the deposits. The annual deposit consists of a layer of *Chlorellopsis* colonies formed during the summer and a thin dense layer without algal structure which was formed in the winter. These supposed annual layers average about 6 millimeters thick and therefore the reef which is about 7 feet thick must have required at least 355 years to form. The bed-like algae reefs of the Green River formation indicate that the ancient lake bottom was nearly flat over large areas and was probably covered by only a thin sheet of water—perhaps between 3 and 15 feet deep. Furthermore the reefs seem to indicate stability of the lake level for periods of time measured in hundreds of years for they grew continuously. Such periods of stability suggest that at those times the lake maintained an outlet, for lakes in closed basins are extremely sensitive to climatic variations and as a consequence fluctuate greatly in volume. (*Author's abstract.*)

F. E. MATTHES: *Influence of secondary faults on the development of the Grand Canyon topography.* The plateau region through which the Grand Canyon is cut is commonly supposed to be made up of several great, massive blocks delimited by north-south trending master faults. As a matter of fact, these plateau blocks, and more especially the Kaibab, are traversed by numerous secondary faults of small throw and diverse trends. Being as a rule loci of relatively rapid erosion, these secondary faults have exerted a profound influence on the topographic development of the chasm. The positions and trends of many branch canyons, gulches, and minor recesses are determined by such faults, and in general the intricate, almost labyrinthine arrangement of the sculputural features of the Kaibab section is expressive of the fracture system as a whole. In the vast panorama that unfolds itself from any prominent point on the rim of the Grand Canyon the presence of the secondary faults is not readily detected by the unaided eye. So small, as a rule, is the throw of these faults that the offsets in the strata are hardly noticeable. However, instrumental determinations of altitude on the sharply defined cliff tiers leave no doubt as to their reality. It was, in fact, in the course of the detailed topographic survey of the Grand Canyon, which was begun by the speaker in 1902, and has been completed recently by Richard T. Evans, that the existence of the secondary faults was first revealed. The elevations required for the contouring of the cliff tiers (several thousand were determined by accurate trigonometric methods from planetable stations on both rims of the chasm) soon developed the fact that there is a sensible break

in the continuity of the strata along the axis of each major side canyon or important cross gulch, likewise at each accentuated constriction, gap, or recess, in the spurs that advance from the walls. Each outlying butte, each "temple," was found to be carved from a separate block having an attitude or tilt of its own. The marked asymmetry of the Kaibab section of the Grand Canyon (the course of the river is on an average more than twice as far from the rim of the Kaibab Plateau as it is from the rim of the Coconino Plateau) is explained not merely by the greater height of the Kaibab Plateau, nor by the fact that the surface of that plateau drains southward, into the Grand Canyon, whereas the surface of the Coconino Plateau drains away from it, but in large measure also by the greater prevalence of secondary faults on the Kaibab side as compared with the Coconino side. Toward the western margin of the Kaibab Plateau the secondary faults become progressively sparser; toward the eastern margin they become increasingly frequent and more closely spaced. The climax of fracturing is reached in the belt immediately west of the east Kaibab fault, where the Algonkian rocks are broadly exposed. To the east of this master fault, on the other hand, the fracturing, as well as the flexing, rapidly die out in the flatlying strata of the Painted Desert. And there, significantly, side gulches are correspondingly rare. That the prevailing scarcity of side gulches in the Painted Desert is not due simply to lack of water is shown by the fact that wherever a fault does extend east of the monocline, there also is a gulch or at least a deep recess.

The extreme head of the Grand Canyon illustrates in a more telling way than any other part of the chasm the important rôle played by secondary fractures in the development of its topography. The chasm begins,—that is, it abruptly flares out from a width of a mile and a half in Marble Gorge to a width of eight miles (on the Kaibab side wholly) at the point where the Colorado reaches the base of the east Kaibab monocline, but this circumstance alone does not account for the remarkable and abrupt increase in width. At this point also begins the system of secondary faults. As this system does not appear to extend northward along the Kaibab monocline (which in consequence presents the appearance of a simple, gullied dip slope), it seems probable that the multiplicity of fractures in the upper part of the Grand Canyon—particularly in the region drained by Nankoweap, Kwagunt, and Chuar creeks—is closely associated with the presence of the Algonkian strata, which form a lens of weak materials intercalated between the Archean rocks and the Palaeozoic strata,—a lens that readily suffered deformation, thereby causing a local intensification of the fracturing of the overlying brittle strata. (*Author's abstract.*)

425TH MEETING

The 425th meeting was held at the Cosmos Club, February 9, 1927, President BUTTS presiding. The Secretary announced with regret the death of Dr. C. D. WALCOTT, Secretary of the Smithsonian Institution, former Director of the U. S. Geological Survey, and a Founder and former President of this Society.

Informal Communications: A. C. SPENCER called attention to an interesting course in geophysics, which some members of the U. S. Geological Survey are taking, offered at the Colorado School of Mines.

C. E. RESSER exhibited an algal "water biscuit" collected by Sir Douglas Mawson from a temporary lake in southern Australia.

Program: WILLIAM W. RUBEY: *The origin of the Mowry shale.* The Mowry shale, a relatively thin member of hard platy shale in the lower part of the Upper Cretaceous series, is widespread throughout the northern Rocky Mountain States. Its peculiar lithologic characteristics are due chiefly to its hardness which in turn is caused by the presence of a large amount of silica. The problem of the origin of this silica is thus a fundamental problem in the origin of the Mowry shale.

Field, microscopic, and chemical evidence from the Mowry shale of the Black Hills region and analogy with similar siliceous shales elsewhere indicate almost certainly that the silica in the Mowry shale was in some way derived from the alteration of volcanic ash. As a probable method of this derivation, it is suggested that the original ash was unusually siliceous, that it was decomposed by long exposure to sea water, and that silica dissolved from it was precipitated by the abundant decaying organic matter. A minor amount of secondary silicification may have occurred during consolidation and weathering. The few tests of siliceous organisms found in the shale are considered merely incidental fossils. The small amounts of clay, silt, and sand in the Mowry shale may be in part more or less altered volcanic products and in part normal clastic sediments. (*Author's abstract.*)

GEORGE W. STOSE: *Possible post-Cretaceous faulting in the Appalachians.* The peneplain developed on the tops of South Mountain and the Valley ridges in Pennsylvania, called the Kittatinny peneplain, has no counterpart in the Piedmont. It is supposed to have been entirely removed by erosion. The peneplain that caps the highest ridges of the Piedmont, called the Schooley peneplain and regarded of later age, is 350 to 500 feet lower. May it not be that the Schooley peneplain is the Kittatinny faulted down?

The Triassic basin is bounded on the northwest by a normal fault of over 6,000 feet vertical throw in the vicinity of Gettysburg. Part of this movement took place near the close of Triassic sedimentation, preceding the formation of fanglomerates at the foot of South Mountain. The larger part of the movement took place after the deposition of the fanglomerate, the latest recorded Triassic sediment. It is suggested that at least part of this later movement occurred after peneplanation and evidence was produced in support of this view.

Profiles at various places across the Appalachians in Pennsylvania were exhibited to show the effect of the application of this theory. The Kittatinny peneplain on South Mountain and the Valley ridges, 1600′–2000′ elevation, becomes the Schooley peneplain in the Piedmont, 1240′–1500′ elevation, with 350 to 500′ displacement; the Weverton peneplain on South Mountain and the Valley ridges, 1140′ to 1600′ elevation, becomes the Honeybrook peneplain in the Piedmont, 750′–1100′ elevation, with 400 to 500′ displacement.

The Harrisburg peneplain is not affected by the faulting. The hypothetical faulting therefore occurred between Weverton peneplanation and Harrisburg peneplanation, probably at the close of the Cretaceous. (*Author's abstract.*)

A. H. REDFIELD: *The Petroliferous Provinces of the United States.* As the major physiographic divisions of the United States formulated in 1916 by a committee of the Association of American Geographers, headed by Prof. N. M. Fenneman, are based primarily on regional structure, they constitute both a logical and a practical scheme of classifying the producing and potential oil fields of the United States.

Petroleum and natural gas have been produced commercially in eight of these major divisions: the Coastal Plain; the Appalachian Plateau; the

TABLE 1—SUMMARY OF THE PETROLIFEROUS PROVINCES OF THE UNITED STATES

PROVINCE	REGIONAL STRUCTURE	TYPE OF PETROLIFEROUS STRUCTURE	AGE OF PETROLIFEROUS BEDS	EST. PROD'N. 1859–1925
				Thous. bbls.
Coastal Plain	Monocline of Cretaceous and Tertiary beds, dipping gently seaward.	*a.* Faults and folds (E. Cent. Tex.).	Up. and Low. Cretaceous.	1,237,383
		b. Broad domes and terraces, less faulted (S, E. Okla., S. Ark., N. La.).	Up. and Low. Cretaceous.	
		c. Faults and folds (S. W. Tex.).	Eocene.	
		d. Salt domes, supposed to be intrusive (S. Tex., S. La.).	Chiefly Oligocene and Miocene.	
Appal'n Plateau	Great spoon-shaped basin of moderately disturbed Palezoic beds.	Small, discontinuous, irregular folds (N. Y., Pa., E. Ohio, W. Va., E. Ky., E. Tenn.).	Ordovician to Pennsylvanian.	1,598,093
Central Lowland	Broadly folded Paleozoic beds.	*a.* Broad flat folds (W. Ohio, Ind., Ill., W. Ky.).	Ordovician to Pennsylvanian.	3,202,663
		b. Imperceptibly folded, slightly dipping beds of varying porosity (E. Kans., Okla. N. of Arbuckle and Wichita Mts.).	Chiefly Pennsylvanian, some from Mississippian and Permian.	
		c. Long, narrow anticlines (Red River Valley of S. Okla. and N. Tex.).	Ordovician, Permian, Pennsylvanian.	
		d. Broad arch, with minor wrinkles (N. Cent. Tex.).	Pennsylvanian.	
Great Plains	Broad basin of moderately folded Paleozoic and Mesozoic beds interrupted by dome-like uplifts of older rocks, (Black Hills, Bearpaw Mts., etc.), veneered by continental Tertiary, partly concealing buried folds and uplifts in older rocks.	*a.* Minor folds along flanks of Rocky Mts. and Black Hills, etc. (Mont., E. Wyo., E. Colo.).	U. Cretaceous; (some Carboniferous and (?) Jurassic).	270,348
		b. Long, buried folds in Paleozoic (Panhandle of Tex., W. Tex., E. N. Mex.).	Permian.	
Wyoming Basin	Broad basin of moderately folded Cretaceous and Tertiary beds, partly concealing north-south folds of older rocks.	Anticlines, some compressed and faulted (W. Wyo., Moffat Co., Colo.).	Upper Cretaceous; some Permo-Carboniferous.	5,523
Colorado Plateau	Tableland of broadly folded, somewhat faulted and intruded, Paleozoic and Mesozoic beds, resting on pre-Cambrian foundation.	Broad regional folds (W. Colo., S. E. Utah, N. W. N. Mex.).	Upper Cretaceous.	415
Pacific Valleys	Great synclines of Tertiary beds, resting on highly folded Mesozoic and older rocks.	Crumpled and eroded anticlines, sealed monoclines (Cent. Cal.).	Miocene and Pliocene; some Upper Cretaceous.	1,290,735
Pacific Coast Ranges	Moderately to complexly folded, faulted, and intruded beds of Paleozoic, Mesozoic, and Tertiary age.	Sharply to moderately folded and faulted anticlines (W. Cal.).	Tertiary, chiefly Miocene and Pliocene.	999,417
			Total	8,604,577

Central Lowland; the Great Plains; the Wyoming Basin; the Colorado Plateau; the Pacific Valleys and the Pacific Coast Ranges (as well as some gas in the Arkansas Valley). In each of these major divisions of regional structure oil and gas occur under characteristic and distinctive conditions of structure and stratigraphy. (*Authors' abstract.*)

426TH MEETING

The 426th meeting was held at the Cosmos Club, February 23, 1927, President BUTTS presiding.

Informal Communications: C. E. RESSER read letters of greetings from Secretary WALCOTT and Dr. A. F. FOERSTE to Dr. E. O. ULRICH on the occasion of his 70th birthday.

Program: ARTHUR M. PIPER: *Metalliferous resources of Silver City, Idaho.* The Silver City region of southwestern Idaho, one of the old precious metals mining camps of the Northwest, has produced about 900,000 ounces of gold and 27,000,000 ounces of silver during the 60-year period from 1863 to 1923. Its decline as a generous producer has been a serious blow to the mining industry of the State, but geologic conditions suggest that its history is not yet closed.

The sequence of events in the legible geologic history has been: (1) intrusion of fine-grained argillite of possible Carboniferous age by late Mesozoic (?) granite, the magma being sodic, highly siliceous, and low in iron and magnesia; (2) regional fracturing; (3) deposition of silver ores in the southern part of the region at Flint, accompanied by intrusion of differentiates from the granite magma; (4) development of a mature erosion surface; (5) explosive extrusion of 1,500 feet of coarse basaltic tuff in early Tertiary time, followed by quiet outwelling of 500 feet of basalt flows; (6) outpouring of 2,000 feet of rhyolite flows, the succession being broken by an erosion interval of unknown age and duration; (7) regional block faulting; (8) deposition of silver-gold ore deposits at DeLamar and in War Eagle and Florida mountains; (9) regional faulting; (10) planation by sub-aerial agents; (11) deep dissection by glaciation and stream erosion.

The geologic structure involves complex block faulting, not recognized heretofore, during three epochs of deformation. The dominant direction of shear for the first epoch is represented by the northward-trending veins of the Flint district. The secondary fractures cause an ever-present polygonal blocking and sheeting of the granite. Maximum crustal shortening was in a northeast-southwest direction, and the stresses were probably rotational. The second epoch involved high-angle block faulting of the granite and extrusives, the fractures being controlled in position by those of the preceding epoch. Certain of the fractures in the acute angles of major crustal blocks, were loci of subsequent deposition of the silver-gold ores. The vertical component of displacement along the major block faults is at least several hundred feet in some localities, and the shove along the fault planes is considerable. The third epoch of deformation is represented by prominent low-angle slicing, chiefly in the DeLamar district. These low-angle fractures have been thought to be older than the vein system but the present investigation has reversed that conclusion. They are normal faults, and the downthrow amounts to several hundred feet, although the shove is probably as much as 1,000 to 1,200 feet.

The ore deposits of the Flint district are found only in the granite. The veins are filled fissures and the dominant gangue mineral is quartz, of which

the greater part is massive. The primary metallic minerals are the sulphantimonides of silver, almost every possible species being present, from silver-free stibnite on the one hand to argentite on the other. Pyrargyrite is the most abundant species. Small amounts of the arsenical silver minerals are also present. These argentiferous minerals are diluted by stibnite, tetrahedrite, and jamesonite, together with small amounts of chalcopyrite, galena, sphalerite, arsenopyrite, and pyrite. Unusual species are miargyrite ($Ag_2S \cdot Sb_2S_3$), xanthoconite ($3Ag_2S \cdot As_2S_5$), and stromeyerite ($Ag_2S \cdot Cu_2S$). Miaragyrite is quite widespread and rather plentiful in the Flint and Florida Mountain ore deposits. The ratio of gold to silver in the ores is about 1 to 700 by weight.

The ore deposits of War Eagle and Florida mountains and of DeLamar extend upward into the extrusives. The veins are filled fissures, vein breccias, and silicified shear zones, the last two types occurring more frequently in the extrusives. Quartz is again the most abundant gangue mineral. A great deal of lamellar quartz, possibly pseudomorphous after calcite, is found at DeLamar, together with beidellite. The Florida Mountain veins are characterized by the presence of cellular calcite, composed of thin plates each extended parallel to the basal plane and intersecting one another at random angles; of the potassic feldspar valencianite; and of beidellite, which in many places constitutes the greater part of the vein filling. The younger deposits are differentiated from those of the Flint district by the presence of a considerable though variable portion of gold and by an abundance of selenides. Gold occurs as the native metal, chiefly in the gold-silver alloy electrum. The comparatively rare silver selenide naumannite (Ag_2Se) equals or exceeds the abundance of argentite. Special mention should be made of owyheeite (essentially a silver-bearing jamesonite), and of the rare lead selenide, clausthalite (PbSe). The non-argentiferous diluents are chalcopyrite, pyrite, galena, and sphalerite, although the ores contain but one or two per cent of these species. Stibnite, tetrahedrite, and jamesonite are also present. The ratio of gold to silver varies from approximately 1 to 1 by weight in the primary zone of the Oro Fino vein of War Eagle Mountain to 1 to 139 at Florida Mountain.

Enrichment of the ore deposits of Florida Mountain by selenide minerals of probable supergene origin has been discovered by Dr. F. B. Laney, formerly of the United States Geological Survey.

The ores are medium- or low-temperature deposits which show no change in mineralogy within the vertical range of mining development, some 1,700 feet, except for the effects of supergene agents. Neither do they differ as they pass from one type of wall rock to another. It is to be expected therefore, that the ore deposits will extend without significant change to depths greater than any yet attained by mining. (*Author's abstract.*)

WALTER N. WHITE: *Recent work on the discharge method of estimating ground water supplies.* This paper describes an investigation begun in 1925 in the Escalante Valley, Utah, to develop the method, devised by G. E. P. Smith and described to the Geological Society of Washington on November 22, 1922, for determining the quantities of water discharged from the zone of saturation by plants that habitually use ground water, such as alfalfa, greasewood, and salt grass. This method is based on daily fluctuations of the water table. Its purpose is to use the discharge of the ground-water plants as a basis for estimating the available supplies of ground water. Automatic water-stage recorders used on 33 wells in localities of ground-water plants showed that during the growing season there is a marked daily fluctuation of the water

table. The water table generally goes down during the day time, when transpiration by the plants is rapid, and rises during the night, when there is little or no transpiration. The daily fluctuations begin in the spring with the appearance of foliage, and cease in the fall after killing frosts. They are absent in plowed fields, cleared lands, and tracts of sage brush. In a field of alfalfa the fluctuations were nearly absent for several days after the alfalfa was cut. The maximum daily drawdown in wells observed during the investigation amounted to about 1¼ inches in a tract of greasewood and shadscale, 2¼ inches in a field of alfalfa, 3¾ inches in a salt-grass meadow, and 4½ inches in a meadow of sedges and associated marsh grasses.

The quantities of water discharged each day were computed, in depth of water over the area, by the formula $y = 24\ r \pm s$. The quantity y is the specific yield, or quantity of water that drains out of the soil when the water table declines, expressed as a percentage of the volume of soil drained. The quantity r is the hourly rate of rise of the water table when the water table is at a mean elevation for the 24-hour period and there is no discharge from the zone of saturation. These conditions are found approximately during the middle of the night. The quantity s, expressed by either the plus or the minus sign, is the net fall or rise of the water table during the 24-hour period. The specific yield was determined by experiments with 16-gage steel cylinders, 1½ feet in diameter and 3 feet high, which were driven into the soil directly above the water table so as to inclose undisturbed columns of soil of the types in which the recorded daily fluctuations took place. After a cylinder had been driven it was converted into a water-tight vessel by soldering to it a bottom of sheet steel, and the top was made proof against evaporation by means of a cover. A well was then sunk into the column of soil, through which measured quantities of water were added or withdrawn and in which the resultant water levels were measured. The specific yield computed from data obtained from the undisturbed soil columns ranged between 2.4 and 9 per cent.

It was demonstrated by two independent sets of experiments that the results obtained by application of the formula to the data derived from the recorders on the field wells are substantially correct, but more refined experiments of the same kind are to be made in 1927. (1) Three soil tanks were used in which alfalfa, greasewood, and salt grass were grown. Each tank was provided with a recharge well, that fed water to the bottom of the soil column, and a shallow well that extended only slightly below the water table. The head in the recharge well was kept constant by means of an automatic device and the quantity of water fed into it during any interval of time could be read from a gage. The shallow well showed the fluctuations of the water table and gave a daily curve similar to those obtained in the field wells. Inventories were made at frequent intervals during the day and night of the water added to the zone of saturation, the net increase or decrease of storage in this zone, and consequently the quantity of water discharged from this zone. (2) By means of a tank experiment, the quantity of water required to produce one pound of dry alfalfa was determined. A measurement was then made of the quantity of dry alfalfa that was raised in a field under observation in which virtually the entire water supply came from the zone of saturation, and the quantity of water consumed in the production of this alfalfa was computed. This quantity agreed closely with that computed, by means of the formula, from the data obtained from an automatic recorder over a well in the same field.

Fstimates were made of the rate of ground-water discharge from tracts having different kinds of vegetation and from the entire discharge area under investigation, but these are to be checked by more intensive work during the summer of 1927.

This investigation was conducted under the direction of E. O. Meinzer, geologist in charge of the division of ground water in the United States Geological Survey, who gave valuable advice at various stages in its progress both as to the methods to be applied and as to the interpretation of the results. (*Author's abstract.*)

GEORGE W. STOSE and ANNA I. JONAS: *Ordovician shale and associated lava in southeastern Pennsylvania.* The Ordovician shale, generally called Martinsburg but locally named Cocalico in the area north of Lancaster, occurs in a broad belt northwest of the Appalachian Valley and in several smaller areas south of the main belt. This shale, which overlies conformably Chambersburg limestone of Black River age west of the Susquehanna, unconformably overlaps on older rocks to the eastward, chiefly Beekmantown limestone of Canadian age but also Allentown limestone of Ozarkian age and Elbrook limestone of Middle Cambrian age.

In the vicinity of Jonestown, north of Lebanon, amygdaloidal basalt occurs at the base of the shale, resting on a floor of Beekmantown limestone. Certain purple and green shales occur at about the same horizon in the shale of the main belt and in most of the smaller areas to the south, and these shales are of volcanic origin according to the belief of the writers.

It is concluded that in this part of Pennsylvania uplift and erosion occurred in late Black River time, preceding Martinsburg shale deposition, and that during the same time basic lava was extruded from a vent near Jonestown. This period of volcanic activity is synchronous with that which produced the purple and green shale of probable volcanic origin in this part of the state and volcanic ash now preserved in the form of bentonite in central Pennsylvania, in Virginia, Tennessee, Kentucky, and Alabama and hence it is suggested that some of these ash eruptions may have come from the same vent as that from which the Jonestown lava came or from some near-by vent. (*Authors' abstract.*)

W. P. WOODRING, W. W. RUBEY, *Secretaries.*

BIOLOGICAL SOCIETY

695TH MEETING

The 695th meeting was held in the new assembly hall of the Cosmos Club October 23, 1926 at 8:10 p.m., with President OBERHOLSER in the chair and 180 persons present.

ALEXANDER WETMORE gave an account of the 44th meeting of the American Ornithologists' Union, recently held at Ottawa. He also gave a short account of Dr. WILLIAM MANN'S African trip.

C. W. STILES discussed the typification of the genus *Sarcoptes.*

DAVID FAIRCHILD gave an account of his recent trip through the tropics of the Old World.

H. C. OBERHOLSER reported, on the authority of another person, a curious case of the behavior of an English sparrow. The sparrow perched near a nest containing young robins. Each time that the parent bird fed the young and flew away, the sparrow flew to the nest. When he lit on the nest, the young robins at once opened their mouths, whereupon he immediately robbed the one that had just been fed of the food that had been given it.

Owing to the nonarrival of the films intended for the evening's program, it was necessary to postpone the announced program until the next meeting. A very acceptable substitute was provided by Dr. B. W. EVERMANN, who showed moving pictures of the elephant seal taken on Guadalupe Island, Mexico, and of the Steller sea lion taken at Año Nuevo Island near San Francisco.

696TH MEETING

The 696th meeting was held in the new assembly hall of the Cosmos Club November 6, 1926 at 8:05 p.m., with President OBERHOLSER in the chair and 227 persons present. New members elected: J. C. BLOEKER, Jr., Mrs. E. S. COBB, H. H. KNIGHT, MARY E. MCCLELLAN, HAROLD ST. JOHN. The program was as follows:

C. R. ASCHEMEIER, National Museum: *A talk on gorillas.*—In 1916 the speaker accompanied Prof. R. L. GARNER to the French Congo to obtain specimens of gorilla and chimpanzee for the U. S. National Museum. Landing at Cap Lopez, they passed up the Ogolelli River to Lake N'kami. Near there the first gorilla was seen, a young one captured by natives. A gorilla footprint seen here was fully 12 inches long. At Lake Ngovi fully 25 were seen together, making a raid on a plantain plantation, and a fine male was taken. From Ogouma a trip was made to Eschira along a trail followed by PAUL DU CHAILLU. At Kruso an old native was seen who claimed to have gone hunting with DU CHAILLU. Between Kruso and Ogouma, on the return trip, a fine gorilla was collected which is now mounted in the National Museum. It was 5 feet 3 inches high, weighed about 350 lbs., and had an expanse of 8 ft. Altogether about 75 gorillas were seen, of which 3 were collected. In general, the fierceness of the gorilla has been exaggerated. The animal usually retreats when possible, but if cornered or wounded fights fiercely. In the French Congo they occur in nearly every kind of country. Some natives do not eat the flesh, while others are very fond of it. In the opinion of the speaker there are not over 1,000 living gorillas, and strict enforcement of the game laws is required to prevent their extermination.

The paper was discussed by T. S. PALMER, C. W. STILES, G. B. SUDWORTH, and others.

The talk was followed by a five-reel picture, "The Gorilla Hunt," taken by BEN BURBRIDGE in the Lake Kivu region, and shown through the courtesy of the "Film Booking Offices of America."

697TH MEETING

The 697th meeting was held in the new assembly hall of the Cosmos Club November 20, 1926, at 8:10 p.m., with President OBERHOLSER in the chair and 84 persons present. New member elected: H. S. BERNTON.

T. S. PALMER gave an account of the game preserve in the Lake Kivu region in Africa, established in 1925 under the name "Parc Nacional Albert." In this preserve, covering about 1,000 square miles, the Lake Kivu gorilla is given absolute protection. The area can be well policed except on the south, where it touches a mandate zone which may at first create some difficulties in administration.

L. O. HOWARD stated that there is now hope of controlling the Opuntia pest in Australia by means of several species of mealybug which have been thoroughly established. Through their attacks the plants become brittle and dry. Unfortunately, one of the worst enemies of mealybugs in the

world, *Cryptolaemus montrouzieri*, is a native insect in Queensland. The outcome of the struggle that is bound to arise will be watched with interest.

B. W. EVERMANN, California Academy of Sciences: *The conservation of the fisheries of the Pacific* (illustrated).—In natural resources of food or other commercial value, the Pacific is the richest of all the oceans. Of marine mammals, including fur seals, sea otters, whales and other cetaceans, sea lions, and the like, there are probably nearly 50 species, most of them at one time exceedingly abundant but now seriously depleted, some of them already commercially extinct. The fisheries proper, especially the Pacific salmon, the most important fishery in the world, are all greatly depleted as a result of inadequate protection. The whale fishery is faring as badly. Of 7 or 8 species found on the California coast only one (the humpback) is now abundant enough to justify whaling operations. Of about 2,000 whales taken on the California coast since 1918, over 90 per cent were of this one species; all the others are already commercially exterminated. The Alaska fur seal herd which, through the killing of females in the sea, was reduced from two to three millions in 1870 to only 127,000 in 1911, has increased since 1912 to 760,000 in 1926, as a result of the protection afforded by the International Treaty of 1912. There are remnants of more than a dozen other fur seal herds which, if given international protection, can be rehabilitated correspondingly. When international protection has been given to all the natural resources that frequent the high seas of the Pacific, they can easily be made to yield annually more than one billion dollars. (*Author's abstract.*)

GEORGE F. MITCHELL, Bureau of Chemistry: *The story of tea* (*illustrated*).—The speaker described the propagation and cultivation of the tea plant, *Thea sinensis*, and the manufacture of commercial tea. He used this as a background against which to show the possibilities of cassina (*Ilex vomitoria*), an indigenous plant growing along the coast from the James River in Virginia to the Rio Grande in Texas. Man in his natural state, that is, unaided by scientific research, discovered and utilized all of those beverage-producing plants which yield the alkaloidal principle, caffeine, as the tea, coffee, Paraguay tea, guarana, and cassina plants. Experiments have shown that cassina can be produced in this country for very much less than the cost of importing commercial tea, owing to the advantages that the cassina offers over tea, in both the growing and curing of the leaves. Tea leaves must be collected by hand, as only the young leaves contain the desired qualities. The cassina plant, however, can be harvested by machinery and the leaves removed by live steam, as all of the leaves can be used in the manufacture of cassina tea. The branches are then cut up by machinery and furnish at least 90 per cent of the fuel for operating the factory. Power and Chesnut have found as much as 1.67 per cent of caffeine in the leaves of cassina, the tannin content of which is much less than that of commercial tea. Experiments with cassina and experience in the growing and manufacture of tea in this country have convinced the speaker that cured cassina can be produced on a scale comparable with the tea gardens of the East Indies for about four cents per pound. Cassina can be made into green and black cassina, which are comparable with the average green and black tea, and also into maté products similar to the Yerba Mate used extensively in South America. Cured cassina is not only being used as a beverage similar to tea and coffee, but also in producing flavoring sirups and flavoring extracts. At the end of the address, carbonated cassina was served to the gathering to demonstrate its use as a flavoring sirup. (*Author's abstract.*)

698TH MEETING

The 698th meeting was held in the assembly hall of the Cosmos Club December 4, 1926, at 8:10 p.m., with Vice-president CHAMBLISS in the chair and 109 persons present. New member elected: D. D. STREETER.

H. D. FISH, University of Pittsburg: *A canoe trip through British Guiana* (illustrated).—The speaker described the botanic garden at Georgetown and Beebe's laboratory at Cartabo, which he occupied with 20 students in 1925. Colored slides of many of the characteristic animals of the region were shown. The method of hunting of the natives, who build platforms over small clear spaces in the forest and watch for game, was described. The speaker then gave an account of a canoe trip to Kaieteur Falls, 750 feet high, on the Potaro River, with splendid photographs of the Falls. He hopes to establish a biological station at this point.

G. C. LEACH, Bureau of Fisheries: *Trout propagation by the Bureau of Fisheries* (illustrated).—The Bureau of Fisheries, which has developed from the U. S. Fish Commission established in 1871, is divided into the Scientific Division, having charge of fisheries investigations; the Division of Fisheries Industries, having as its object the collection of statistics and the rendering of aid to the commercial fisheries in marketing their products; the Alaska Division, having charge of the enforcement of regulations covering the protection of the Alaska salmon, and also of the seals on the Pribilof Islands; and the Division of Fish Culture, having charge of the propagation and distribution of fishes throughout the United States and Alaska. There are 35 regular hatcheries and 65 sub-hatcheries. The Division of Fish Culture employs approximately 450 persons. The output of fish during the fiscal year 1926 was 5,232,000,000. Approximately 35 species of fish are propagated by the Bureau of Fisheries. Methods of propagation vary widely. Brook trout and rainbow trout yield to artificial propagation better than any other species. The brood stock at the hatcheries is held in ponds and the eggs are taken at certain seasons of the year and placed in hatching troughs where they are incubated in water having a temperature of 40° to 56°F. Brook trout eggs are collected during October, November, and December. They require approximately 30 to 35 days to hatch in a temperature of 50°F. Rainbow trout spawn during April and May, their incubation period being approximately the same as brook trout. The young fish are supplied with a yolk sac which contains enough food to last for 30 days. After absorption of the food sac the fish are fed on such artificial food as beef heart or beef liver ground to a pulp. They are distributed or placed in streams when about two to four inches in length. Those held at the hatcheries for future brood stock reach the spawning age at from 2 to 3 years. An average 3-year-old brook trout will yield approximately 800 eggs. The eggs average from 350 to 500 per fluid ounce. The trout hatcheries are located in the mountain States in the East and West. Brook trout and rainbow trout are not propagated farther South than North Carolina and Tennessee. They prefer swift cool streams with gravelly bottoms. (*Author's abstract.*) S. F. BLAKE, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

The Petrologists' Club met at the Geophysical Laboratory on April 19. Program: R. W. GORANSON, *Density of subcrustal material from gravity measurements;* G. W. MOREY, *The system,* $SiO_2 - H_2O$; E. G. ZIES, *The concentration of metallic constituents by fumarolic activity. Example, the Valley of Ten Thousand Smokes.* Officers for the next season were elected, as follows: *Secretary,* GEORGE TUNELL; *Steering Committee,* L. H. ADAMS, W. F. FOSHAG, J. GILLULY. A field trip in the vicinity of Baltimore, under the guidance of J. T. SINGEWALD, was decided upon for May 7.

Obituary

DR. WILLIAM HEALY DALL, a member of the ACADEMY, died in Washington March 27, 1927, at the age of 81 years. Dr. DALL was born in Boston, Mass., and was educated in New England schools. His interest in natural history led him to become a pupil in natural sciences under Louis Agassiz, and his most important work was in that branch of knowledge, though his interests were very wide and his early contributions to anthropology, geology, and geography of Alaska rank high. In his later years Dr. DALL was one of the world's foremost students of recent and fossil Mollusca, his studies ceasing only with the inception of ill health two months before his death. He was for more than forty years Paleontologist in the U. S. Geological Survey and Honorary Curator of Mollusks in the National Museum.